GSP2204 SCIENCE, TECHNOLOGY & SOCIETY

LECTURE NOTES

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LECTURE NOTES

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SCIENCE, TECHNOLOGY & SOCIETY

CONTENTS

1. WHAT IS SCIENCE?

The words '*science'* is derived from the Latin words '***scientia'*** which means '**knowledge'** (Encho, 2000). On the simplest level, science has been defined as the knowledge of the world of nature (The New Encyclopedia Britannica, 1995). The above definition however does not exhaust the full meaning of science. So it is difficult to define it. However, science generally is regarded in three main ways as (Nwala, 1997):

a. A body of knowledge
b. A method for acquiring knowledge or studying and understanding the world.
c. An institution.

a. SCIENCE AS A BODY OF KNOWLEDGE

The bodies of knowledge generally regarded as science include, chemistry, biology, physics, mathematics, microbiology, pharmacy and medicine. These bodies of knowledge differ from other forms of knowledge such as religion and arts in both content and form.

b. SCIENCE AS A METHOD FOR ACQUIRING KNOWLEDGE OR STUDYING AND UNDERSTANDING THE WORLD.

Science has well-known procedures for obtaining knowledge. The two branches of science which are empirical and formal sciences use what is called scientific method. Anybody that uses the scientific method to obtain knowledge is said to be involved in science. The steps of that method include observation, problem hypothesis formulation, experimentation, conclusion and theory formulation.

c. SCIENCE AS AN INSTITUTION

Science can be viewed as an institution which comprises millions of experts. These experts engage in the study and development of human knowledge. The experts or scientists can be found in various research and educational institutions, industries, hospitals, companies etc. The operation and interaction among them make the development of science possible and reliable.

2. BRANCHES OF SCIENCE

Basically there are two ways of grouping science:

a. The first way is to group scientific disciplines into:

i. Formal Science:

Science is said to be formal if its contents, arguments and procedures obey certain rules and the result and conclusions of such sciences are valid and authentic only if they conform to those rule (Nwala, 1997). Formal sciences include mathematics (which comprises *geometry, algebra, trigonometry* and *arithmetic's*), logic, theoretical physics, and statistics. Formal sciences have a formal and deductive character. For example, in mathematics there are rules for addition, subtraction, multiplication and division where the rule of BODMASS is followed.

ii. Empirical Sciences

These study objects and phenomena which can be observed through any of the senses and which can be tested with instruments such as the telescope, microscope, rulers, tapes and scales. It includes physics, chemistry, biology, psychology, botany, zoology, biochemistry, microbiology, geology, medic sciences etc. In other words, anything that cannot be observed with the senses of sight, touching, hearing, tastes and smell or with instruments such as ruler, telescope etc. is outside science. Thus, empirical scientists observe and experiment in order to find out how things originate, grow or develop, function and relate to each other. They also try to find out the laws which govern their behavior. They are interested in regularities or laws, which enable them to understand or explain the objects or phenomena under study. The knowledge derived in empirical sciences includes *inductive generalization*, *laws* and *theories*.

2. The second way of grouping scientific disciplines is according to the class of objects or phenomena they deal with for example,

a. Physical science: which include disciplines like physics, chemistry, geology, applied mathematics, astronomy, etc. These deal and inanimate objects such as rocks, rivers and mountains.

b. Biological science: disciplines under it include biology, zoology, botany, microbiology. These deal with living bodies such as human being, animals, insects and plants.

c. Medical sciences: they include general medicine, anatomy, physiology and veterinary medicine. These disciplines deal with objects and problems that affect human and animal health.

d. Pharmaceutical sciences: which include pharmaceutics, pharmaceutical chemistry, pharmacognosy and pharmacology. These disciplines are concerned with drugs and drug contents of plants and other objects.

3. AIMS OF SCIENCE

1. Science aims at enabling man to explain how the world, events and objects around him originate, develop, operate or function.
2. It is also helps hum to predict how they will behave in future and thus enables him to control the behavior of the things around him, once he is able to develop the appropriate instruments for such control.
3. It equips us with theoretical knowledge about the world. Such knowledge is usually summarized using concepts laws, and theories. These help us to express and systematize our understanding of object phenomena.
4. Science also equips us with practical knowledge in terms of the various ways, mechanisms and instruments which enable us to control objects and phenomena.
5. Science is therefore, not only a source of knowledge; it is also a source of power.

4. DIFFERENCES BETWEEN SCIENCES AND NON-SCIENCES DISCIPLINE

Examples of non-science discipline are religion, arts, metaphysics (a branch of philosophy), mysticism, common sense, imagination etc.

1. Religion, for instance, is concerned with worship of the supernatural, while science is concerned with nature and natural phenomena and objects. In particular, religion is speculative. It is based on faith or dogma. While science, on the other hand, is jot dogmatic. It is based on reason and does not accept any idea on belief on faith.
2. In the field of study called rational religion or theology, the aim is to make religious beliefs reasonable without rejecting them. In other words, theology tries to confirm religious beliefs. Religion relies on the principle that the universe is governed by spiritual laws.
3. All the other non-sciences exhibit some of these attributes. Thus non-sciences are said to be subjective, unverifiable, non-factual, not objective, not systematic and not quantifiable (that is measurable). On the other hand, science seeks knowledge that is objective, certain, systematic, provable and supported by evidence. It subjects everything under its study to critical examination. It does not accept anything as sacred and unquestionable. It relies on the principle that the universe is governed by material law which may be mechanical, electrical, chemical, biological etc.
4. The study of non-sciences is often a matter of involving trial and error. Consequently, knowledge based on them does not enable us to explain, predict and control phenomena in the way scientific knowledge can. It further overcomes the limitations of the senses through the use of instruments, diagrams, equations and formal symbols.
5. However, some have argued that science differs from non-science only in degree. It is pointed out, for example, that common sense has a certain scientific character. It recognizes certain basic laws of nature and acts on their basic for example, traditional agriculture, which is based mainly on common sense experience, recognizes the laws governing soil fertility.

6. On the other hand, science involves a certain degree of speculation and imagination especially at the level of formulating hypothesis.
7. In general, science is said to be objective, systematic, reliable etc.
8. Science being reliable means, that it can enable us to adequately and correctly explain, predict and control any phenomenon in question. Thus science differs from non-science in method and in the systematic characters of its knowledge.

5. SCIENTIFIC METHOD OF ACQUIRING KNOWLEDGE

Most of the steps are common place procedures carried out by people on a daily basis. Taken together they amount to one of the Powerful tools man has devised to know and to control nature.

The steps of science include the following:

1. **Observation:** is the first step of scientific method. Thus anything that cannot be observed cannot be investigated by science. For example, a young student observes that maize grains which were placed in a wet container inside a dark cupboard, germinated, but that the leaves were pale yellow instead of the normal green colour of leaves (Olorode and Kioh, 2000). Scientific observation can be both direct and indirect. Direct observations are made with the aid of senses just as our hypothetical students observed the maize grains with his eyes. Indirect observations are performed with the aid of instruments. Atomic nuclei and magnetism, for example, cannot be perceived directly through our sense organs, but their effects can be observed with instruments.

   Observations can also be classified into:

   a) Spontaneous or passive observations which are unexpected
   b) Induced or active observations, which are deliberately looked out for.

2. **Problem definition:** this step, questions are asked about the observation. If our hypothetical student in (1) above shows further curiosity, he will decide to find out why those seedlings and pale yellow leaves instead of green. This is the definition of the problem. He asks

himself, 'Why are the leaves pale yellow instead of green?' This is the kind of causal question that the scientific that the scientific method deals with. Science is fundamentally about finding answers to questions.

3. **Hypothesis formulation:** This is the third step of the scientific method. Do you know that this involves as the seemingly quite unscientific procedure of guessing? One guesses what the answer to the question might be. Scientists call this assumed answer hypothesis. A given question, as you might be aware, may have thousands of possible answers but only one right answer. Thus, there are excellent chances that a random guess will be wrong. The scientist will only know if this guess was correct after he must have completed the fourth step of the scientific method, which is experimentation (The nature of science). The main function of a hypothesis is to predict new experimentation or new observation. This out hypothetical students in (2) above will try to state all the possible explanations of his observation or all the possible solutions to the problem he defined. One possible explanation he might give is the pale yellow colour referred is the characteristic of the particular variety of maize that was germinating in the dark cupboard. Another explanation he might give is that the pale yellow colouration resulted from the exclusion of light. Since is the function of every experiment to test the validity of a scientific guess the fourth step of the scientific method as experimentation.

4. **Experimentation:** You might aware by now that answers without evidence are really unsupported options. Experimentation can provide the necessary evidence and anyone who experiments after guessing at answers becomes truly 'scientific; in his approach. Experimentation is by far the hardest part of the scientific method. There are no rules to follow each experiment is a case unto itself. Technically, knowledge and experience usually help. Making a correct decision on the means by which a hypothesis might best be tested shows the difference between a genius and an amateur (The nature of science). Can you think of how the young student in our hypothetical example would gather evidence in

order to refute or confirm his hypotheses? Let us examine the two hypotheses regarding the young man's observation was that the yellowing was due to the variety of maize germinating. A simple way to test that hypothesis is to collect various varieties of maize, put them in the dark cupboard and observe the results. All the varieties will be round to have produced the same pale yellow leaves. The other hypothesis, which a state that the exclusion of light produced the pale yellow leaves effect, can also be easily rested. This is done by germinating a batch of seeds in the dark and another batch in a well-lit condition. The well-lit condition serves as the control. It provides a standard of reference for assessing the results of the experimental series. It would be found that the seedlings in the dark would be pale yellow while those in a well-lit condition would have the normal green colour. What do you think gives the green colour in plants?

5. **Conclusion:** We shall again illustrate this step with our hypothetical example above. The test of the first hypothesis leads us to reject that hypothesis while our test of the second hypothesis leads us to accept the second (alternative) hypothesis. Thus, our respective conclusion.
   a) Yellowing of the leaves was not due to the variety of maize germinating.
   b) Exclusion of light caused the yellowing of the leaves.

   Scientific conclusion can be redefined, modified and clarified when the situation arises. Some other conclusion may even be overthrown and discarded. For instance, the young man who observed the pale yellow leaves of the maize seedlings may want to find out if the same result will be obtained with seedlings of others plants. He may also observe that in a large maize farm, some rare seedlings which lack green pigments completely may exist. This will lead him to modify his original conclusion. He may add that other factors besides lack of light may cause yellowing of leaves.

6. **Theory Formulation:** The final step of scientific method is theory formulation. It differs from a scientific hypothesis in its breadth of application. A theory is usually proposed when a hypothesis has been supported by really convincing evidence.

6. WHAT IS A SCIENTIFIC THEORY?

A scientific theory is an explanation about the cause of causes of a broad range of related phenomena. A theory explains how things are related or their common properties. Scientific research (using the scientific method) leads to the accumulation of facts about nature.

This theories start as hypothesis or tentative formulation meant to explain the phenomenon under investigation. When hypothesis is confirmed through experimentation, it becomes a theory. Theories take various forms, which may be as diagrams, equations, statistical and propositional formulations. A theory is formulated in such a way that its range of application is indicated.

In conclusion, theories enable us to explain, predict and control phenomena. They also provide us with a new way of looking at a familiar object or phenomenon.

Some these scientific theories include the theory of evolution by natural selection, they theory of universal gravitation, atomic theory, quantum theory, genetic theory, relativity theory etc.

7. THEORY OF EVOLUTION

A scientific theory is an explanation about the causes of a broad range of related phenomena. Scientific theories include the theory of universal gravitation, the theory of evolution by natural selection, atomic theory, relativity theory, quantum theory etc.

Theories of evolution propounded before Darwin include the theory of spontaneous generation and doctrine of fixed species of creation.

Events that led to the revival of discussion on evolution include:

1. The discovery of many more kinds of organisms by the first part of the eighteen century.
2. The study of fossils which showed that layers of sedimentary rocks held different kind of fossils. The fossils also appear in chronological order the deeper the layers, the older the fossils it contains.
3. Comle de Buffen's observation that all mammals he studied had common features.
4. Iames Hutton's hypothesis that sedimentary rocks that encased fossils were formed by the gradual accumulation of sediments in lakes, rivers and oceans, thus indicating that the earth was millions rather than thousands of years old.
5. The proposition of Lamarck's theory of inheritance of acquired characteristics.
6. Some of Darwin's pieces of evidence that evolution occurs including the following:
    a. Extinct species such as the glyptodonts most closely resemble the living armadillos in the same area, suggesting that one had given rise to the other.
    b. Layers of sedimentary rock held different kinds of fossils and they appeared chronological order.
    c. Populations of similar kinds of organisms that lived in different geographical region showed noticeable differences in some of their characteristics. For instance, the giant tortoises in the Galapagos Islands were not identical; thus indicating to Darwin those species might have descended from the same ancestral form but had slightly modified after they became isolated on different islands.

With the aid of those pieces of evidence, Darwin declared that was natural selection, that nature selecting the 'fit' and rejecting the 'unfit' that lead to modifications in members of species. That means that natural selection is

the mechanism that leads to evolution. Thus, Darwin theory consists of two major parts:

a) Concept of evolutionary change, and
b) The concept of natural selection.

After Darwin's death, field of inquiry such as paleontology, genetics, biochemistry, embryology, geology, etc. have produced results that have led to a better understanding of the mechanism of evolution.

The field of genetics, particularly, through the laws of inheritance proposed by Gregor Mendel has given evidence of how desirable characteristics are transmitted from parents of offspring.

8. LAWS OF NATURE

Theories that have proved to be so universally valid or true and have such a high degrees of probability are called natural laws. In general, laws of nature refer to the following:

- Those uniformities found in nature (behavior, function, relations and properties of things).
- Established connection of successive events which make up the order of the universe.
- Theories established through scientific research.

Examples of laws of nature are the:

a. Law of the uniformity of nature
b. Law of causation
c. Law of gravitation
d. Law natural selection

The entire universe is said to show uniform patterns and form a united system. This view is called law of the uniformity of nature.

Gravitation is the force which pulls every object in the universe towards every other object in the universe. It is the force that makes a body fall through space toward the earth. The first scientific explanation (theory) of the behavior of falling objects was given by Sir. Isaac Newton (1642-1727). Albert Einstein's theory of relativity which was formulated in 1905 explained the Newtonian theory further by asserting that gravitation is a property of space. Within this clarification by Einstein and others the theory of gravitation was elevated to the rank of a law. The basic idea of the law is that if the mass (amount of matter) of one of the two attracting bodies is doubled, the gravitational attraction will also be doubled, but if their distance apart is doubled, the force will be only quarter as great gravitational attraction explains the behavior of falling objects and the motions of the moon and the planets and other motions we observe on earth.

HISTORY AND PHILOSOPHY OF SCIENCE

Man and his Cosmic Environment

The cosmos is the world or the universe

Cosmology therefore is:

1. The branch of philosophy, which studies the structure of the universe. It deals with its origin and general structure, its part, elements, laws. It focuses on such characteristics of the universe as space, time, causality and freedom.
2. Also the branch of astronomy, which deals with general structure and evolution of universe. It studies composition extent and origins of the universe and its various components.

The Cosmic Environment

The cosmic environment is the entire universe in which we live, especially those of its aspects or parts that are connected with human life, survival and interests. The structure of the cosmos as revealed by astronomy includes the

earth (and other planets), their satellites, the sun and other stars, the groups of stars called galaxies, etc. Man depends on air, heat, water and other natural resources from the entire cosmos, particularly his own earth and the sun for survival.

The earth

The earth on which man lives is a planet or satellite of the sun. The earth is one of the nine planets, which rotate on their axis and revolve around the sun. The earth is spherical in shape and moves around the sun in space.

1. **Rotation of the Earth** - it takes the earth approximately 24 hours (around the equator) to rotate or turn on its axis. This rotation gives rise to day and night as the earth faces or turns away from the sun. The earth derives its light from the sun. When it faces the sun it is day for that part of the earth, when it turns away, it is night for that part so affected.
2. **Rotation of the Earth -** it takes the earth about 365 days (i.e. one year) to complete one revolution around the sun. The sun is at the centre around which the earth and all the other planets (or satellites of the sun) revolve. The earth is 93 million miles away from the sun. It is 4,000 miles in radius. Because of its spherical shape and its flattered shaped around the poles, its diameter is 13 miles shorter at the poles that the equatorial radius. The equatorial diameter is 79,261/2 miles, while the polar diameter is 7,900 miles.
3. **Spheres of the Earth –** the most important spheres of the earth are the following:
   a. **The biosphere:** this is the part of the earth's crust, water and atmosphere where living organism can subsist.
   b. **The atmosphere:** this is the gaseous envelope (air) surrounding the earth. It is of mixed gases consisting of Nitrogen (7,554.9) Oxygen (23 – 14%) Argon (1.2%) and Carbon Dioxide (0.05%).

THE SOLAR SYSTEM

The solar system is composed of the sun and the nine planets that revolve around it and the satellites, plus the minor planes called asteroids make up the solar system. The system is held together by the gravitational force of the sun. The sun is a star, one of the innumerable starts in the universe. The nine planets which revolve around the sun in different orbits are (according to their proximity to the sun):

1. Mercury (no satellite) – smallest planet
2. Venus (no satellite) – most brilliant planet in the solar system
3. Earth (no satellite or moon)
4. Mar (2 satellites)
5. Jupiter (12 satellites) – largest planet in the solar system
6. Saturn (10 satellites) – second largest planet
7. Uranus (5 satellites)
8. Neptune (2 satellites)
9. Pluto – the outermost planet in the entire solar system

Man and his natural resources

Man's existence is sustained not only through the process of biological reproduction of his existence and his offspring, but through the utilization of the materials resources from his natural environment. These include air (especially oxygen), water, food, economic, resources (such as agricultural, fishing water, animal foods, etc.) mineral resources (such metal, gold, silver, iron, ore etc.); fuels (such as coal, gas, wood, etc.).

The sun supplies him solar energy and light. The plants provide him oxygen and energy through foods of various kinds. From the foods, he derives energy which enables him function physically and biologically to reproduce the cells and all the basic organs of the body. From natural resources, he gets energy and other economic resources including things he needs for technological construction – shelter, road, bridges, electrical installations, communication and all types of industrial plants, equipment, spare parts,

transportation equipment, etc. It is important to know that the process of interaction and the necessity of survival has forced man to learn to manipulate natural factors and forces to his benefit.

Man and his food

Man sustains himself through food and essentials of life such as air and water. The food he eats derives from plants and animals. Some types are eaten just as they are derived from nature, for example, fruits, vegetables, and roots. Some are cooked or prepared in different ways, for example fruits, seeds vegetables, roots, animals etc. Some are manufactured in different sophisticated ways, e.g. cereals, sugar, oil, flour, meat, etc. which are canned or turned into other forms.

Agriculture and industry have therefore become the major institutions through which man feeds himself.

Types of food

There are three different types of food. Generally, plants are responsible for the production of the basic food needed by both plants and animals through a process called photosynthesis which is made possible by the energy from sunlight and water (through their toots) and air (carbon dioxide) through the stomata in its leaves. Plants first convert water and air into glucose – a simpler form of sugar. This gives it potential energy. In the process of producing glucose, plants release oxygen, which essential for man. Animals use oxygen while plants need carbon dioxide. When plants take in carbon dioxide, it releases oxygen. This interdependence between man and plants in their air consumption is called symbiosis. The earth is the only celestial body presently known to contain enough oxygen, the all-important element for the sustenance and nourishing of life.

Basic foods needed by man

The basic types of food needed by man include:

a. **Carbohydrates:** it is the main source of energy needed by plants and animals. The three main types of carbohydrates are sugar, starch and cellulose.
b. **Fats and oil:** plants produce fats from carbohydrates.
c. **Proteins:** like carbohydrates and fats, protein contains oxygen, hydrogen and carbon.
d. **Mineral and vitamins:** minerals are important to both animals and plants. They are important constituents to human bones, teeth and body and cells needed for the formation of blood, liver, muscles etc. Three types of minerals are iron, calcium and phosphorous. Calcium is derived from cheese and milk, phosphorous from cheese and lives, iron for liver, bread, peas and cabbage. Vitamins are essential to the enzyme system of all organisms, which enhance chemical reactions necessary for converting food into energy. Man needs an adequate and balanced proportion of these types of food for his normal growth. Hence, he needs what is called a balanced diet.

Agriculture, climate and soil

Man's ability to produce his food and agricultural needs depends on the type of climate, weather, and soil of the region in which he lives. From ancient times, man has known these secrets about nature. Hence, the areas that first saw the earliest human settlements and the emergence of ancient civilization were areas favourable for agriculture and general human settlements. Such areas include the Nile valley, the valleys of Tigris and Euphrates in Babylonia, the Yangtse river of China and the Indus river in India. In these areas, the valleys were found fertile and very conducive for agriculture and secure settlements. The rivers in these areas often over flowed and spread silt, rich with mineral deposits and nutrients which helps crops to grow

abundantly. In this way man was able to produce enough food to support a large population all year round.

1. **Climate** - is the generally prevailing weather conditions of a region. It is determined by the temperature, barometric pressure, humidity, precipitation, sunshine, cloudiness and winds, throughout the year. It is the average condition over a period of years. Precipitation is the falling down of products of condensation in the atmosphere. Such products include rain, snow and hail.
2. **Weather** - is the prevailing state of the atmosphere as regards wind, rain, temperature, moisture, cloudiness, pressure etc.
3. **Soil –** is the portion of the earth's surface consisting of disintegrated rocks and humus.
4. **Humus -** is the dark organic materials in soils produced by the decomposition of vegetable or animal matter, which is essential for the fertility of the earth or ground. Disintegration or breakdown of rocks, which produces soil, is accomplished by a process called weathering. It is done by ice and frost naturally occurring chemicals and lowly plant organism such as algae or lichens. Soil has inorganic components such as clay, soils and sand. These are mixed with organic portion called humus.

Natural Resources

The natural resources is used to signify those thing (raw materials) man uses to satisfy his needs. Natural resources in this sense mean such things as minerals, fuels, forest, grazing lands, wild-life, etc. However, with the development of ecology (the science that explores the relationship between life and the environment in which it occurs), the term natural resource(s) was introduced to include all the things that could be found on the surface layer of our planet earth, namely, the earth's crust which is about 33km deep at most of the oceans and seas, the atmosphere which is made up of three layers – troposphere, the stratosphere and the ionosphere.

The reason for this is that it has been recognized that earth takes its life supporting from the continuous interaction of the various elements within it. Thus, the earth's surface forms an integrated life-supporting unit, which is called the biosphere. The biosphere was we saw in unit 1, includes part of the earth's crust, water and the atmosphere where living organisms including man subsist.

Man derives his sustenance from the biosphere just as he makes some input towards the maintenance of the equilibrium of the biosphere. However, man's contribution towards the maintenance of the equilibrium of the biosphere is now in doubt, hence the present drive to curb the ecological damages perpetrated by man. You may recall that in module 3, unit 2, we talked about the social implications of man's technological development.

Classification of Natural Resources

You may be aware that natural resources could be classified in two way which are:

1. **Living resource** - living resources include all forms of plants and animal life as well as micro-organisms.
2. **Non-living organism** - are those without life, for example, minerals. They could also be classified into:
   a. Renewable, and
   b. Non-renewable resources

a. Renewable - these are resources that can reproduce or renew themselves, for example, plants, and animal resources. Resources are also classified as renewable when they are maintained, rejuvenated or improved upon a naturally occurring process. An example is soil formation. The natural process of soil formation goes on at all times, building up of soil and restoring of destroyed soil. In addition, seemingly inexha

b. Non-renewable resources - these are those resources (mostly living resources such as fuels and minerals), which do not usually replace themselves once they are used.

However, the classification of resources as renewable and non-renewable is not to satisfactory, given the fact that it is known that all form of natural resources are integrated in a continuum, consisting of those that are renewable over a short time and those that are renewable over a very long period of time. It is, therefore, necessary to see all forms of natural resources in terms of their cycling time. The cycling time of resource is the period it takes to replace a particular quantity of such a resource that has been used with an equivalent quantity in the same useful form. Thus, the difference in terms of renewability between the tropical trees we lumber for timber (for instance, iroko, obeche) and petroleum (a fossil fuel) will be the 400 - 1000 years it takes the fossil to get renewed. A resource is non-renewable if the rate of its consumption or utilization surpasses its cycling capacity. When an easily renewable resource (e.g. fish) is consumed at a rate that would render it non-renewable, such a resource is said to be 'mined'.

Conservation of Natural Resources

The danger presented by non-renewability of resources on a large scale has created the need for the conservation of natural resources. The term conservation as presented in world conservation strategy by the international union for conservation of nature and natural resources means the management of human use of the biosphere so that it may yield the greatest sustainable benefit while maintaining its potential to meet the needs and aspirations of future generations. Conservation is carried on for other reasons apart from making resources available on a long-term basis. These other purposes are scientific, recreational and aesthetic.

Conservation activities serve science because through conservation, species of life and biological communities are preserved for scientific study. The disappearance of such species of life and biological communities when they have not been adequately studied or studied at all is great loss to science and scientific understanding for the biosphere.

Aesthetically and recreationally, conservation is required to preserve some of nature for people living in the urban areas who yearn to come in contact with nature. For instance, people living in the urban areas usually like to see animals such as lion and elephants in their natural habitats. It also provides camping sites as well as recreational facilities. An example is the Yankari game reserve in Bauchi state.

Management of non-living resources the way and objectives of managing and conserving resources are different from those concerning the management of living resources. Non-living resources are managed by:

1. **Beneficiation:** this is the process of care whereby a resource that occurs in an uneconomical formation is upgraded or improved, i.e. rendered economically viable. Beneficiation usually depends on technological improvements, for instance, manganese, cobalt, nickel and copper that are relatively scarce on dry ground are continuously formed as nodules on the ocean floor. These nodules await the technology that would enable human beings collect them.
2. **Maximization:** this is the sum of those measures that make for the avoidance of waste and which also increase the production of a resource.
3. **Substitution:** this is the utilization of readily available resources in place of a rare one. For instance, the use of plastic in place of metals for packaging and other purposes and the use of aluminum in place of copper for certain purposes.
4. **Allocation:** this involves the determination of the best use of particular resource and the scheduling of such a resource for that use. Mechanism for allocation in the market (capitalist) economic is the pricing system. It depends on demand, which, once high, is likely to lead to a high price. High price for a particular resource will more or less ensure its utilization for the expected purpose. This mechanism is not very reliable because it is not quite amenable to long-term conservation purpose. For instance, petroleum goes into all sorts of products, whereas one may wish to conserve it for energy purpose only.

5. **Recycling:** this is the gathering of waste or used materials, reprocessing them, and using them again in place of fresh materials. The effectiveness of recycling depends on its being organized and sustained on a large scale. Living resources could also be recycled, for instance wood and paper could be reused.

Management of living resources

The aims or purpose of managing living resources include:

1. To maintain very important ecological processes and life support systems.
2. To preserve the diverse and various life forms (i.e. plants and animals)
3. To establish a sustainable pattern of how to use species and ecosystems.

The conservation of living resources involves:

1. Protection and restoration of endangered species through the development of parks, game reserve, etc.
2. Recycling which involves the processing of already used materials for re-use.
3. Specie substitution, this is the use of readily cultivatable species in place of species with long period of cycling. For instance, the use of Kenaf trees for pulp in place of certain kind of timber.

GREAT SCIENTIST OF NIGERIAN ORIGIN

Col. Dr. Oviemo O. Ovadje

He is chief consultant Anesthesiologist. He has been recognized worldwide due to his contribution to product development in medicine. He invented an Emergency Auto-Transfusion Set (EATSET) which has been acclaimed internationally as Nigeria's contribution to Global Blood Safety. He has received many awards among which are:

1. Best African Inventor/Scientist Award, 1995
2. First African Winner, World Health Organization Sasakawa Award, UN Hall, Genera Switzerland, 18 May 2000.
3. Winner ARCO Excellence in Science and Technology Award, Dorchester, London England April 26, 2001.

Prof. Henrietta Ukwu

She also received the ARCO Award on 26th April, 2001 for the production of potent chicken pox vaccine (varivax) and an HIV-protease inhibitor (crixiran) for managing AIDS patients.

Prof. Njoku Obi

In the early 1970s, Prof. Njoku Obi of the University of Nigeria, Nsukka made a vaccine which was recognized, accepted and adopted for use by the World Health Organization (WHO).

Prof. Bartholomew Nnaji

He is from Umuode in Nkanu East Local Government Are of Enugu State, Nigeria. He was born in July, 1956. he studies at St. John's University, New York, Virginia Polytechnic and Massachusetts Institute of Technology (MIT). He became a professor and founder of Automation and Robotic Laboratory at the University of Massachusetts at Amherst. He is the founder of Geometric Machine Corporation to affirm that everything in use has a geometric approach. He founded the National Centre for Computer-Aided Medical Devices for Visualization Diagnosis and Surgical Intervention System. He is the first man to be named a distinguished professor of engineering if American history.